



STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

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STATE PROJECT: 8.1910203 (R-977A) FEDERAL PROJECT: FR-14-1(1) COUNTY: Cherokee DESCRIPTION: US-64 From US 19-74-129 in Murphy to East of NC-11 SUBJECT: Geotechnical Report - Inventory

Project Description

This project is located in south-eastern Cherokee County, beginning at the intersection of US 19-74-129 and US-64 in Murphy. It involves a major relocation and eventual widening of US-64. The relocation is mainly to the south of the existing highway. Its eastern terminus occurs less than one kilometer from the Clay County Line, where the proposed alignment rejoins existing US-64. The total length of this proposed relocation is 7.7 kilometers.

Existing US-64, in a 5 kilometer corridor eastward from its intersection with US-19, is characterized by sharp curves and narrow pavement. Shoulders or benches at grade are nonexistent in several areas where existing rock cut slopes skirt the edge of pavement and show evidence, in many places, of past failures. The new alignment will begin with a 560 meter, five to six lane curb and gutter intersection that will transition to a four lane divided highway with a typical 14 meter grassed median with dual 7.2 meter travel lanes, 3.6 meter shoulders, and an additional 8.3 meters to the ditchline. At this time, only the right two lanes of this project are proposed to be built. All data reported herein will pertain to this two lane facility.

Four bridges are proposed on this project. The first will carry -LREV- (US-64) over the Hiwassee River and is approximately 234 meters in length. The second structure will carry -LREV- over -Y2-, (SR-1558), and is 45 meters long. The third is also a grade separation bridge that will span -Y3-, (SR-1558), and a small creek. It will be 96 meters in length. The fourth proposed bridge will again cross the Hiwassee River and is 125 meters long.

Physiography and Land Use

This project is located in the Murphy Belt of the Mountain Physiographic Province. Topography is rolling and mountainous, with local relief approaching 150 meters. The Hiwassee River and its many tributaries provide the drainage for the project. The Hiwassee River will be traversed twice along this corridor, along with many of its tributaries. It has developed a broad, gently rolling floodplain in some areas, in others it is deeply incised with little floodplain development. The river subparallels the alignment for most of its course.

Aside from the town of Murphy at the beginning of the project, the area is characteristically rural, consisting of small and large farms, scattered residences, and large areas of continuous woodlands. Several residences, one church, and the Town of Murphy's old water plant are the only developments within the construction limits of this project.

Soil Properties

Subsurface materials consist of minimal existing embankments, alluvium, residuum, weathered rock and hard rock. Plastic Indices were low throughout the project corridor. Existing embankments are minor along this project. They consist of very loose, silty sands and stiff to very stiff, fine sandy silts.

The alluvial deposits along the corridor vary with their respective locations. Alluvial deposits near the small unnamed branches and ephemeral drainages are generally less than one meter in depth, consisting of very soft to very stiff, silty sands, clayey silts and silty clays, all with varying amounts of small rock fragments. Alluvial deposits near the larger, named creeks, are generally less than two meters in thickness and consist of soft to stiff, fine sandy silts. The alluvial deposits of the Hiwassee River, near the sites of the proposed crossings, are varied, both in their thicknesses and their compositions.

Near the first crossing, at the beginning of the project, the alluvium ranges from just under two meters to just over three meters in thickness and consists mainly of very loose to medium dense, silty sands and soft to stiff, sandy silts. The deposits near the second crossing are more varied and much more widespread. A wide floodplain (nearly 800 meters along centerline) has developed here. The alluvium in this area is composed of interlayered, very soft to very stiff, silty and sandy clays and loose to very dense mixed sands, silts, and gravels. These deposits range from just over one meter to over six meters in depth. The clays are generally found at the surface and the gravels at depth, following the fining upward sequence typical of an old age meandering river.

Residual silts and clays occur sporadically along the corridor. They are generally 0.5 to 2 meters in depth and have consistencies from very soft to hard, with the majority being soft to medium stiff. The saprolitic soils along this corridor are mainly composed of silts, varying from clayey to sandy, sandy silts being the dominant soil type. Very few silty sands, and only a few silty clays were encountered along the project.

The subsurface investigation was conducted from mid-May through August 1996. Borings were advanced using a CME-550 ORV drill unit and a B-57 truck-mounted drill rig. Eight-inch hollow augers, NXWL drill rod and casing, and hand augers were utilized in the investigation. Standard Penetration Tests (SPT) were performed at selected sites using an automatic hammer and representative samples were obtained for the determination of Atterberg Limits and quality. Undisturbed Shelby Tubes, bulk samples, and CBR's were also obtained to be tested for Triaxial Shear, permeability, consolidation, recomacted density, and bearing capacity. Rock core specimens were retrieved and analyzed for structural attitude, discontinuities and Net Neutralization Potential using the acid-base accounting method.

The following base lines and station intervals were investigated.

Table with 2 columns: Base Line and Station Interval. Lists various base lines like -LREV-, Y, -YIREV-, etc., and their corresponding station intervals.

Areas of Special Geotechnical Interest

(1) Springs near or inside proposed construction limits.

Table with 2 columns: Station Interval -LREV- and Station Interval -Y3-. Lists specific station intervals for these areas.

Consistencies for the silts ranges from very soft to hard, the majority being very stiff to hard. Varying amounts of rock fragments and intermittent very thin to very thick, soft weathered rock seams were also encountered. Black, slick manganese-oxide seams were found in many localities in the saprolite and soft weathered rock horizons. These seams vary in thickness up to 10 mm. These seams are mostly parallel to the remnant foliation of the parent rock (concordant with the soil layers) and may provide a surface for planar failures. Except for its hardness, the composition of the soft and hard weathered rock is the same as that of the overlying saprolite. These materials (residuum and weathered rock) exhibit distinctive variegated colors, from dark red to yellow, purple, brown, and green.

Geology and Rock Characteristics

The Geologic Map of North Carolina places the entire project corridor in rocks of the Mineral Bluff Formation associated with the Murphy Belt. It is described as being composed of dark to light gray-green, thinly laminated to thinly bedded, quartz-chlorite-sericite schist and phyllite with thin discontinuous quartzite layers. These rocks are not very resistant to chemical or physical weathering as evidenced by the thick deposits of residuum and soft weathered rock that have developed from them. The alignment crosses the Mary King Mountain Fault, a post-metamorphic thrust fault, which is a primary fault within the Murphy Belt.

Rock was encountered at several locations along the corridor although only small outcrops were observed. It will be found above grade in several cut sections as noted in section (7) above, although saprolite and predominately soft weathered rock will dominate these cut sections.

Rock core specimens retrieved from the cut section at Stations 20+80 to 23+20 yielded RQD values ranging from zero to 100 percent. RQD values did not necessarily increase with depth. The mean recovery and RQD values for all runs in the two core borings was 94 and 60 percent, respectively. The core was typically a light, gray-green phyllite with fairly consistent foliation angles of 45 degrees. Most joints are planar to wavy, and parallel to foliation. Notable iron-staining (weathering) was only observed in the first 2 to 3 meters of core. Iron-staining was almost non-existent at depth. No infilling was observed.

Four specimens were tested, using the acid-base accounting method, for their Net Neutralization Potential. Values ranged from -7.89 to -17.40. Since the project corridor traverses just one rock type, all hard rock excavated from the cut sections should be considered moderately acid producing. Test results for these four specimens are included in this report.

Groundwater Properties

Due to the rolling and mountainous terrain this project corridor traverses, groundwater depths will vary along its length. Many small tributaries and ephemeral drainages are found, mainly beneath proposed fill sections. Several wet cuts, as outlined above, with mostly perched water tables were also encountered. Groundwater within 1.8 meters of finished grade will be found in only two locales, in the vicinity of Stations 33+40 and 76+40.

(2) Wells near or inside proposed construction limits.

Station Interval -LREV-

47+02, 17m RT 82+67, 10m RT 84+74, 32m LT

(3) Septic Tanks near or inside proposed construction limits.

Station Interval -LREV-

47+08, 33m RT or 17+40, 22m LT, -Y3- 82+67, 15m RT 84+65, 28m LT

(4) Intervals involving groundwater within 1.8 meters of ground surface.

Station Interval -LREV-

15+50 - 16+13 } Floodplain Hiwassee River 17+56 - 19+71 } Floodplain Hiwassee River

Table with 3 columns: Station Interval -LREV-, Station Interval -Y3-, and Station Interval -Y6-. Lists various station intervals for these areas.

The above stations, excluding the first two intervals, involve small creeks, most less than one meter wide and less than 15cm deep, floored by silt, sand, and small rock fragments. They involve very little floodplain development. Alluvium is generally less than one meter in depth. Some of these stations involve ephemeral streams and all are underlying varying amounts of fill.

(5) Sections where groundwater can be expected within 1.8 meters of proposed grade.

Station Interval -LREV-

33+39 - 33+41 76+30 - 76+80

Two major culverts have been proposed for this project. The first is to carry Martin Creek under -LREV- at approximate Station 23+51. Three different alternative locations have been proposed for this culvert. Proposed is a dual 3.4 x 3.5 RCBC with a beveled headwall. The most recent design indicates it will be approximately 110 meters long. The second culvert is proposed to carry Hampton Creek under -LREV- at Station 35+18.5. The proposed culvert is a dual 2.2 x 2.1 RCBC with a tapered inlet and beveled headwall. It is to have an 83 degree skew relative to the centerline and is approximately 165 meters in length.

Geotechnical Descriptive Analysis of the Project

This project will be divided into individual base lines for descriptive purposes. Further subdivision will be made on the basis of proposed construction variances (cuts versus fills). -Y- Lines will be mentioned with their corresponding -LREV- Sections, but detailed descriptions will be discussed separately.

Stations 10+00 to 13+00

This interval involves a transition from the six-lane curb and gutter intersection to the presently proposed two-lane facility with variable 12.6 to 7.2 meter travel lanes, 3.6 meter shoulders, and an additional 4.5 meter to the ditchline. Line -LREV- begins its rightward (Southward) shift away from existing US-64 here. Shallow fills over existing embankment (Stations 13+00 to 14+50) and alluvium (Stations 14+50 to 15+66) are proposed in this section. Existing embankment is that for US-64 and was not investigated. The alluvial deposits are less than three meters in thickness and are composed of a brown, moist to wet, very loose, silty sand (A-2-4), with minor clay seams. Saprolite, a greenish-gray, moist to wet, very stiff to hard, sandy silt (A-4) and soft weathered rock underlie the alluvium. Line -YIREV- begins at -LREV-, Station 14+87. Murphy's old water plant that still contains active water lines will be affected by the construction within this interval.

Stations 15+66 to 18+00

Proposed within this interval is construction of a bridge over the Hiwassee River. Four preliminary hollow auger borings were advanced near the end bent locations to establish subsurface conditions for the proposed structure. Both end bents are located on the floodplain. The alluvial deposits in this area are approximately three meters in depth, and consist of a brown, moist to wet, very loose to loose, silty sand (A-2-4) with thin clay seams. Alluvium within the river channel is probably no more than one meter in depth and is composed of sands and gravel. Saprolite underlies the alluvium on the left of end bent one (Centerline, -LREV-). The saprolite horizon is 1.2 meters thick and is composed of gray to tan, sandy silt. Soft weathered rock underlies the saprolite and no rock was encountered to a depth of over 7.0 meters. At all other borings, the right end of EB1 and south of the river channel at EB2, a very thin seam of soft weathered rock underlies the alluvium and directly overlies hard rock. Hard rock is present at a depth of 3.4 to 3.8 meters. Shallow rock is likely within the river channel.

(6) Sections where groundwater is expected or found above grade (wet cuts).

Station Interval -LREV-

21+40 - 22+60 31+20 - 31+60 59+60 - 61+20

(7) Cut sections containing hard rock at or above grade.

Station Interval -LREV-

20+80 - 23+20 31+00 - 33+00 33+80 48+60 - 48+80 80+60 - 81+00 *

* Ground surface elevation on plans does not coincide with elevation observed in the field. Rock will most likely be near or below grade.

Station Interval -Y- Lines

10+76 - 12+60, -Y1REV- 18+55.9 - 19+17, -Y3-

(8) Acid Producing Rock:

Four rock core samples taken in the large cut section between -LREV- Stations 20+00 to 23+20 were tested for their Net Neutralization Potential (NNP). The results indicate a potential for acid drainage by exposing these rocks. Since the entire project is underlain by the same geologic formation, all hard rock excavated on this project should be considered potentially acid producing.

(9) Soils with Liquid Limits greater than 50.

Station Interval -LREV-

63+52, 15m LT 65+92, 21m RT 71+32, CL 74+92, CL

Stations 18+00 to 19+70

The interval between Stations 18+00 to 19+26 involves a fill section that will be placed on the Hiwassee River floodplain. This area is currently being utilized as crop land. The embankment will be less than 8 meters in height throughout this interval. Between Stations 19+26 to 19+70 involves the construction of a bridge that will carry -LREV- over -Y2-, (SR-1558). Four preliminary hollow auger borings were advanced near the proposed end bents. Alluvial silt and sandy silt deposits are about two meters in thickness. Consistencies range from loose to medium dense for the sand and soft for the silt. Underlying the alluvium in all borings except at Station 19+70 CL is soft weathered rock. In this boring, a one meter thick hard, brown, fine, sandy silt (A-4) saprolite underlies the alluvium. Hard rock is present across the interval from 3.1 to 3.8 meters in depth. Depth to groundwater will be less than 1.8 meters throughout this interval.

Stations 19+70 to 23+25

The alignment in this interval traverses a large cut section. Depths of excavation in this section will reach over 40 meters and will include rock quantities. Typical materials include a thick sequence of soft and hard weathered rock with sparse intermittent seams of hard, sandy and clayey silt saprolites. These weathered rock horizons are 15 to 20 meters in thickness. They cap a gray-green, talc phyllite that is well foliated at 45 degrees. This rock is moderately to heavily weathered in the top two to three meters. Rock Quality Designation (RQD) values ranged from poor to excellent, with most runs averaging 60 percent - fair. The majority of the joints are parallel to foliation, show no weathering (except in the top two core runs), and infilling is not present. Joint surfaces are very smooth to wavy. Hard rock will be found above grade between Stations 20+80 to 23+20. Small areas to the right of and at the centerline, and most areas left of the centerline have a thin veneer of residuum. Isolated areas will have thicknesses up to 7 meters. These soils are comprised of orange-brown and green, moist to dry, very stiff to hard, sandy clays and clayey or sandy silts. Soft weathered rock fragments and small clay seams are also found within these soils. Perched groundwater will daylight in this cut section. It is found at or near the weathered rock/hard rock interface on the right side of the centerline.

Stations 23+25 to 30+63

The alignment crosses a series of heavily forested valleys and ridges through this interval. Numerous transitions from cuts to fills will prevail.

The interval between Stations 23+25 to 24+80 involves a fill section that is up to 9.5 meters in height. In this interval, a culvert has been proposed to carry Martin Creek under -LREV-. Three possible locations have been proposed for this dual RCBC. Martin Creek is roughly six meters wide, up to one meter deep (in isolated spots), and is floored by silt, sand, and hard rock. Alluvial deposits found near the edge of the creek are comprised of brown, moist to wet, soft to stiff, sandy silt and loose, silty, coarse sand. These deposits are generally less than 1.6 meters thick. Soft weathered rock directly underlies the alluvium except at Station 24+44, 28 meters right,